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*Indian Standard*  
SPECIFICATION FOR RHEOSTATS

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# Indian Standard

## SPECIFICATION FOR RHEOSTATS

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# *Indian Standard*

## SPECIFICATION FOR RHEOSTATS

### 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 15 January 1979, after the draft finalized by the Electrical Instruments Sectional Committee had been approved by the Electro-technical Division Council.

**0.2** This standard is intended to establish uniform requirements for judging the properties of wire wound rheostats. Rheostats are widely used as adjustable resistors in the electrical circuits.

**0.3** In majority of applications, where rheostats are used, it is immaterial whether they are slightly inductive or non-inductive and therefore no reference is made to the inductance in this standard.

**0.4** Information to be supplied by the purchaser with enquiry is given in Appendix A. Information regarding temperature measurement and clearances and creepage distances have been covered in Appendices B and C respectively.

**0.5** In the preparation of this standard, assistance has been derived from BS 280 : 1957 Field rheostats and rheostats for other purposes, issued by the British Standards Institution.

**0.6** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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### 1. SCOPE

**1.1** This standard covers requirements and tests for various types of continuously rated rheostats required for regulating the field current of rotating electrical machines and rheostats used for similar other electrical purposes.

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\*Rules for rounding off numerical values ( *revised* ).

**1.2** This standard does not cover the rheostats where ac characteristics are of critical importance ( *see 0.3* ).

## **2. TERMINOLOGY**

**2.0** For the purpose of this standard, the following definitions shall apply.

**2.1 Rheostat** — An adjustable resistance so constructed that its resistance may be varied without opening the circuit, in which it may be connected.

**2.2 Field Rheostat** — A rheostat designed for connection in the circuit of a field winding of an electrical machine.

**2.3 Open Type Rheostats** — A rheostat in which the live parts are exposed.

**2.4 Enclosed Rheostats** — A rheostat that has an enclosure.

**2.5 Regulating Switch** — An adjustable or moving contact which connects successively with one or more fixed contacts which are in turn connected to various taps on the resistors.

**2.6 Straight Type Rheostat** — A contact type rheostat in which fixed contacts are arranged in one or more straight lines.

**2.7 Face Plate Type Rheostat** — A contact type rheostat in which fixed contacts are arranged on a plane surface.

**2.8 Parallel Rheostat** — A rheostat which is connected in parallel with the field. Two terminals are considered standard.

**2.9 Series Rheostat** — A rheostat which is connected in series with the field, for example, rheostat for the regulation of a shunt field. Two terminals are considered standard.

**2.10 Voltage Divider Rheostat** — A rheostat in which whole resistor is connected across the supply and field is connected between the moving contact and one end of the resistor. Three terminals are considered standard.

**2.11 Reversing Voltage Divider Rheostat** — A voltage divider rheostat which is so connected that it controls and reverses the potential applied to the field.

NOTE — Many other forms of rheostats are made, but most of them are the combination of the basic types defined above.

**2.12 Limit Switch** — A switch which is mechanically operated ( usually by the member carrying the rheostat moving contact ) to prevent over-travel of a motor operated rheostat. It may be combined with interlock contact.

NOTE — For the purpose of the standard the terms ' variable resistor ' and ' adjustable resistors ' are deprecated.

**2.13 Rated Resistance** — The nominal resistance value marked on the rheostat.

**2.14 Rated Current** -- The nominal current value marked on the rheostat.

**2.15 Type Tests** — Tests carried out to prove conformity with the requirements of specification. These are intended to prove the general qualities and design of a given type of rheostat.

**2.16 Routine Tests** — Tests carried out on each rheostat to check requirements which are likely to vary during production.

### 3. SERVICE CONDITIONS

**3.0 General** — Rheostats complying with this standard are suitable within the limits of ratings for installations where conditions are not more severe than those stated in 3.1 to 3.3.

**3.1 Ambient Temperature** — a peak value not exceeding 45°C with an average value not exceeding 40°C over 24 hour period.

**3.2 Altitude** — an altitude not exceeding 1 000 m above sea level or equivalent pressure, that is, 90 kPa.

**3.2.1** When rheostat intended for service at high altitude is tested near sea level the limits of temperature rise as given in 5.1 shall be reduced by 1 percent for each 330 m above sea level at which the rheostat is intended to work in service. The correction shall not apply for altitudes below 1 000 m.

**3.3 Atmosphere** — an atmosphere not subjected to excessive pollution by smoke, chemicals, salt laden sprays, etc. Such pollution occurs in industrial areas and in some coastal regions.

NOTE — The tests may be carried out at prevalent ambient conditions. However, in case of any dispute the tests shall be carried out at  $27 \pm 2^\circ\text{C}$  and a relative humidity of  $65 \pm 5$  percent.

## 4. RATINGS

**4.1 Mechanical Duty** — The rheostat should be rated for the following duties:

- Class 1    10 operations per hour
- Class 2    40 operations per hour
- Class 3    6 000 operations per hour

NOTE 1 — One operation means one movement of the contact in one direction over all or any part of rheostat.

NOTE 2 — Rheostats rated as Class 1 would normally be used for hand control of generator voltage and for such applications as controlling the speed of dc motors driving machine tools.

Rheostats rated as Class 2 would be used for cyclic process control and for voltage control of generator when the rheostat is working in conjunction with an automatic voltage regulator.

Rheostats rated as Class 3 would be used on servo or closed loop controls.

All ratings may be applied to either hand or power operated rheostats.

**4.2 Current Rating of Resistor** — The various sections of the rheostat should be capable of continuously carrying those currents for which they are rated with a temperature rise not exceeding the limits specified in 5.1.

**4.3 Current Rating of the Regulating Switch** — The regulating switch shall be rated in accordance with the largest current which the switch is capable of carrying continuously. If the switch is for an intermittent duty, this shall be stated together with the rated current.

**4.4 Rated Voltage** — The rated voltage of a rheostat shall be the voltage of the circuit for which it is designed.

## 5. DESIGN

**5.1 Temperature Limits** — The temperature rise of metallic rheostat shall not exceed 375°C at any point as measured by thermometer or thermocouple placed in contact with resistance material (see B-2 and B-3).

**5.1.1** For rheostats having an embedded resistive conductor, the temperature rise shall not exceed 300°C as measured by thermometer or thermocouple (see B-2 and B-3) in contact with the surface of the embedding material or sheath in case of metal sheathed elements.

NOTE 1 — Where the temperature of any exposed portion of enclosure is liable to exceed 80°C, the apparatus should be guarded or located to prevent accidental contact by personnel.

NOTE 2 — Where the temperature of any exposed portion of the enclosure or issuing air is liable to exceed 240°C, the apparatus should be so guarded or located as to prevent contact by combustible materials.

NOTE 3 — For determining temperature rise values, the rheostat shall be mounted in the position declared by the manufacturer.

**5.2 Contacts and Conductors** — Continuously rated contacts and conductors shall be capable of sustaining their rated full load current continuously after having reached a steady temperature corresponding to full load without damage to themselves and without causing damage to any adjacent part.

**5.3 Operating Coils ( If Fitted )** — The value of the temperature rise should not exceed the value specified in Table 1, when measured by thermometer or thermocouple on the surface ( *see B-2 and B-3* ).

**5.3.1** If measured by self-resistance method ( *see B-4* ), the limits of temperature rise may be 20°C higher than those given in Table 1.

**TABLE 1 LIMITS OF TEMPERATURE RISE FOR COILS IN AIR**

( *Clauses 5.3 and 5.3.1* )

INSULATING MATERIALS	MAXIMUM SURFACE TEMPERATURE RISE		
	Shunt Coils Continuously Rated °C	Shunt Coils Intermittently Rated °C	Series Coils °C
(1)	(2)	(3)	(4)
Class Y	40	45	55
Class A	70	75	85
Class E ( materials possessing a degree of thermal stability higher than Class A )	85	90	95
Class B	100	105	115
Class F ( as Class B but with superior bonding substance )	120	125	130
Class H	145	150	155

NOTE — For determining temperature rise values, the rheostat shall be mounted in the position declared by the manufacturer.

**5.3.2** For continuously rated coils, the limits of temperature rise apply when coils are left in circuit continuously at rated voltage and at rated frequency in the case of alternating current.

**5.3.3** For intermittently rated coils, the limits of temperature rise apply when cycle of operation is performed continuously at the intended intervals of time.

**5.4 Grading of Resistance** — If the resistance steps are not specified, then the steps shall be so graded as to give approximately even regulation of controlled quantity [ *see A-2(f)* ].

**5.5 Tolerances on Total Resistance** — A tolerance not exceeding  $\pm 20\%$  percent from the specified total value of resistance is permitted. If closer limits are required or if limits are required at intermediate points on the rheostat, these should be specified while ordering.

## 6. CONSTRUCTIONAL REQUIREMENTS

**6.0 General** — No readily inflammable material should be used in the construction of the frame supports, or enclosure of the rheostats.

**6.1 Provision for Earthing and Continuity** — The metallic enclosure of all rheostats shall be provided with an earthing terminal of adequate size.

NOTE 1 — It is not necessary to provide earthing of isolated metal parts not connected to the exposed metal.

NOTE 2 — If the mounting frame of the rheostat on which its enclosure is fixed is metallic, it is not necessary to provide the earthing terminal. The mounting frame may be earthed suitably.

**6.2 Joints** — All joints between electrical conductors and resistors which are soldered shall have the parts mechanically secured together in such a way as not to depend on the solder for electrical continuity. No solder shall be used which has a fusing point less than 50°C above the maximum working temperature attained by the rheostat.

NOTE — This requirement shall not apply to external conductors and sockets into which they are soldered.

**6.3 Terminals** — The position of screws or terminals where the external loads are to be connected shall be easily accessible for making the connections without tilting the rheostat. It shall also be possible to remove, or make electrical connections with the rheostat in the mounted position.

**6.4 Method of Operation** — The following shall be the methods of operation.

**6.4.1 Direct Hand Operation** — Where the rheostat and its operating mechanism compose one complete unit.

**6.4.2 Remote Hand Operation** — Where the rheostat and its operating mechanisms are arranged for separate mounting.

**6.4.3 Power Operation** — Where the moving contact is actuated by a power unit which may be an electric motor, solenoid, hydraulic or pneumatic cylinder, etc, and rheostat may be controlled from a distance.

Where brush arm is not visible, some indication of its position shall be given.

**NOTE** — If the rheostat is operated by a hand wheel, it is recommended that the handle used should operate in a clockwise direction to increase the quantity controlled, speed, volts, etc. Owing to variety of applications to which rheostats are put, it is only possible to give a very general recommendation concerning the movement of hand wheels.

## 7. TYPES OF ENCLOSURE

**7.0 General** — The following types of enclosures are considered adequate for most of the situations and are preferred.

**7.1 Protected (General Purpose)** — An enclosure in which the internal live and moving parts are protected mechanically from accident or inadvertent contact and it does not provide protection against damp and dust and is normally ventilated.

**7.2 Drip Proof** — An enclosure with openings protected so as to exclude liquid or solid particles falling on the rheostat.

**7.3 Dust and Damp Protecting** — An enclosure similar to type given in 7.1 but with joints and openings in the enclosure so packed and/or fitted as to prevent the ready ingress of dust, textile flyings and moist air.

**7.4 Waterproof (Weather Resistant)** — An enclosure so constructed that it is suitable for operation under specified weather conditions without further protection.

**7.5 Hose Proof** — An enclosure constructed in such a way that water supplied in the form of a hose stream in accordance with IS : 2106 (Part XI)-1965\* will not enter it in an amount sufficient to interfere with successful operation of the enclosed rheostat.

**7.6 Dust Proof** — An enclosure so constructed that the dust of specified fineness and nature may not enter in an amount sufficient to interfere with the successful operation of enclosed rheostat.

**7.7 Water Tight** — An enclosure so constructed that it will exclude water under prescribed conditions which include a limited period of submersion when tested in accordance with IS : 2106 (Part X)-1965†.

**7.8 Flame Proof** — An enclosure complying with the requirements of IS : 2148-1962‡.

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\*Environmental tests for electronic equipment: Part XI Water spray test.

†Environmental tests for electronic equipment: Part X Water immersion test.

‡Specification for flameproof enclosures of electrical apparatus.

## 8. METHOD OF MOUNTING

**8.0 General** — The rheostats are intended to be fixed to a rigid structure or foundation. If there is any flexibility in the mounting or the rheostat is likely to be subjected to vibration or shocks, the manufacturer should be given full details in order that a suitable rheostat may be supplied.

**8.0.1** When any rheostat is to be mounted in such a position that there would be danger from contact with other materials, the type of the enclosure chosen should be such as to prevent such danger.

**8.1 Method of Mounting** — The following shall be the methods of mounting.

**8.1.1 Front of Board or Wall Mounting** — Where the rheostat is arranged for mounting on the front of switch board or other vertical support.

**8.1.2 Back of Board Mounting** — Where the rheostat is arranged for mounting at the back of switch board with operating handle in the front of the switch board.

**8.1.3 Floor Mounting** — Where the rheostat is arranged to stand on the floor.

**8.1.4 Ceiling Mounting** — Where the rheostat is remote hand operated and is arranged for suspension from a horizontal support.

## 9. MARKINGS

**9.1** The rheostat shall have a name-plate which shall be clearly and indelibly marked with the following particulars:

- a) Manufacturer's name or trade-mark;
- b) Manufacturer's model number or type number;
- c) Total resistance in ohms ( nominal value only );
- d) Continuous maximum current;
- e) Rated voltage;
- f) Serial number; and
- g) Type of enclosure.

**9.1.1** The rheostat may also be marked with the ISI Certification Mark.

**NOTE** — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution ( Certification Marks ) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers of processors, may be obtained from the Indian Standards Institution.

**9.2** If in the interest of cooling, the direction of mounting is important, the correct position may be marked clearly or specified in the literature.

**9.3** The mounting and overall dimensions shall also be specified in the literature.

## 10. TESTS

### 10.1 Classification of Tests

**10.1.1 Type Tests** — The following shall constitute type tests and shall be carried out in the sequence given below:

- a) High voltage test ( **10.2** ),
- b) Test for ohmic resistance ( **10.3** ),
- c) Test for temperature-rise ( **10.4** ),
- d) Main current heating test ( **10.5** ),
- e) Test on shunt coils ( **10.5.1** ),
- f) Mechanical endurance test ( **10.6** ), and
- g) Vibration test ( **10.7** ).

NOTE — Tests specified in (d) and (e) shall be carried out concurrently, if appropriate.

**10.1.1.1 Number of samples and criteria for conformity** — The type tests shall be applied to three test specimens, in the event of any one specimen failing to comply with the requirements in respect a further set of three specimens shall be taken, all of which shall comply with the requirements of this standard.

**10.1.2 Acceptance Tests** — The following shall constitute acceptance tests and shall be carried out in the sequence given below:

- a) High voltage test ( **10.2** ),
- b) Test for ohmic resistance ( **10.3** ), and
- c) Main current heating test ( **10.5** ).

**10.1.2.1 Sampling plan for acceptance tests** — See Appendix D.

**10.1.3 Routine Tests** — The following shall constitute routine tests and shall be carried out in the sequence given below:

- a) High voltage test ( **10.2** ), and
- b) Test for ohmic resistance ( **10.3** ).

**10.2 High Voltage Test** — Enclosed rheostats shall be tested with cover open or closed, after exposure of the component parts to the ordinary atmosphere for at least 24 hours prior to commencement of test.

**10.2.1** The test voltage shall be 1 000 V ( rms ) plus twice the rated voltage of the rheostat, with a minimum of 2 000 V ( rms ) and shall be applied between the circuit of the rheostat and the nearest earthed metal part with all the circuits of the rheostat completed and also the main terminals with potential circuits connected at one pole only; and finally between live parts forming portions of independent circuits.

**10.2.2** Pilot motors and other ancillary apparatus may be disconnected during test and tested separately in accordance with the relevant Indian Standards.

**10.2.3** The test voltage shall be ac and of any frequency between 20 to 100 Hz and of approximately sine wave form. The duration of full test voltage shall be one minute.

NOTE — An insulation resistance test is not specified as it is not practicable to set down limits for the range of apparatus covered in this standard. Further it is considered that high voltage test determines whether insulation is satisfactory or otherwise.

**10.3 Test for Ohmic Resistance** — The total ohmic value of the rheostat shall be proved by test to be within  $\pm 20\%$  percent of the rated value. It shall further be proved by test that the ohmic value of the resistance under circuit is progressively reduced step by step from 'all in' to the 'all out' position and that the grading curves complies reasonably with that specified.

**10.4 Test for Temperature-Rise** — The test shall be carried out to prove that the rheostat complies with 5.1 for temperature limits.

**10.5 Main Current Heating Test** — Tests on main current carrying parts shall be carried out for dc apparatus with continuous maximum current ( dc ) and rated voltage and for ac apparatus with continuous maximum current ( ac ) and rated voltage at 50 Hz. Connecting conductor shall be normal size for rated currents.

**10.5.1 Test on Shunt Coils ( if Applicable )** — For dc apparatus shall be carried out with dc supply at declared voltage. Test on shunt coils for ac apparatus shall be carried out at declared voltage and frequency to prove the compliance with 5.3.

**10.6 Mechanical Endurance Test** — The mechanical endurance test shall be made by operating the rheostat the specified number of times without current through the resistor or contact. A power operated rheostat shall be operated by its own power unit; a hand operated rheostat may be operated by hand or by a temporary power unit ( see 10.6.2 ).

NOTE — No adjustment other than to the contacts ( main, auxiliary or limit switch ) shall be permissible during the test and such adjustments shall not exceed one for Class 1, five for Class 2 and ten for Class 3.

**10.6.1** The test shall be so applied that each operation comes to at least a quarter of the total movement and on appropriate number of operations shall embrace any limit switch or auxiliary contacts, if fitted, so that these are also tested.

**10.6.2** The number of operations to be made in carrying out this test are as follows:

<i>Class</i>	<i>Main Contacts</i>	<i>Auxiliary Contacts or Limit Switches</i>
Class 1	10 000	10 000
Class 2	200 000	50 000
Class 3	4 000 000	250 000

**10.6.3** At the end of the test, all parts shall be in working order and shall be without permanent distortion and due wear.

**10.6.4** After mechanical endurance test (10.6), the test for ohmic resistance (10.3) shall be done to verify if the nominal resistance of the rheostat falls within the tolerances specified.

**10.7 Vibration Test** — Vibration test shall be performed optionally on rheostats for special purposes, when required. The details of the test method and the severity shall be as decided between the manufacturer and the user.

## APPENDIX A

( Clause 0.4 )

### INFORMATION TO BE SUPPLIED BY THE PURCHASER WITH ENQUIRY

#### A-1. INFORMATION RELATING TO RHEOSTAT

- a) Type of the rheostat ( see 2.2 to 2.11 );
- b) Type of enclosure, if required ( see 7.2 to 7.8 );
- c) Rating in operations per hour;
- d) Method of mountings;
- e) Method of operation;
- f) Maximum current;
- g) Total ohms value required in rheostat;
- h) Whether tappings are required to be taken out for any special purpose, such as synchronizing, automatic voltage regulator;
- j) Rated voltage; and
- k) Limiting dimensions.

**A-2. INFORMATION RELATING TO THE MACHINE FOR WHICH A FIELD RHEOSTAT IS TO BE SUPPLIED**

- a) Types of machine, that is, generator, motor, etc;
- b) Field resistance, hot and cold;
- c) Maximum excitation voltage;
- d) Whether separately or self-excited;
- e) In case of self-excited machines, at least two intermediate values, of field current and corresponding ohmic resistance in the rheostat or preferably a graph showing the relationship between current and resistance and rheostat position; and
- f) If any special grading is required, full particulars to be supplied of the ohms per step or alternatively a graph of characteristics of machines and percentage variation of speed (or voltage) required per step.

**A-3. INFORMATION RELATING TO A RHEOSTAT FOR OTHER PURPOSE**

- a) Type of rheostat ( *see 2.2 to 2.11* );
- b) Type of enclosure ( *see 7.2 to 7.8* );
- c) Rating in operation per hour;
- d) Method for mounting ( *see 8* );
- e) Method of operation ( *see 6.4* );
- f) Maximum or minimum current;
- g) Total ohmic resistance required in rheostat;
- h) If any special grading is required, full particulars to be supplied of ohms per step;
- j) Type of terminals; and
- k) Rated voltage.

**A-4. INFORMATION REQUIRED FOR POWER OPERATED RHEOSTATS**

- a) Type of drive and power supply available,
- b) Frequency and speed of operation,
- c) Whether provision is to be made for emergency hand operation,
- d) Whether provision is to be made for electrically operated brake on the wiper shaft,
- e) Whether provision for limit switch to indicate end of travel is required, and
- f) Whether limit switch is required at any other position of the wiper other than the end positions.

## **A-5. INFORMATION RELATING TO SERVICE CONDITIONS**

**A-5.1** If operating conditions differ from those laid down for the ambient temperature and barometric pressure, the actual conditions should be stated.

## **A P P E N D I X   B**

*( Clause 0.4 )*

### **TEMPERATURE MEASUREMENT**

#### **B-0. GENERAL**

**B-0.1** In order that the measurement of temperature may produce consistent results, certain precautions shall be observed. Those necessary in the case of control gear are specified below.

#### **B-1. RECOGNIZED METHODS OF MEASURING TEMPERATURE**

**B-1.1** Three methods of measuring temperature are recognized as follows:

- a) Thermometer method,
- b) Thermocouple method, and
- c) Self-resistance method.

#### **B-2. THERMOMETER METHOD**

**B-2.1** There are three types of thermometers, namely, bulb thermometer containing mercury or alcohol and resistance thermometer. Any of them may be employed for temperature rise measurement.

**B-2.2** When bulb thermometers are used in places where there is any varying or moving magnetic field, those containing alcohol may be employed in preference to those containing mercury.

**B-2.3** When thermometer is used to measure the temperature of surface, such as that of coil, the bulb shall be wrapped with a single tin foil having a thickness not less than 0.03 mm. The foil should be turned up at the end to form a complete covering of the bulb, which shall then be secured in contact with the surface under test. The exposed part of the wrapped bulb shall be completely covered with the pad of heat insulating material without unduly shielding the test surface from normal cooling.

**B-2.4** When a thermometer is used to measure the temperature of a resistor, the tin foil wrapping of the bulb shall be omitted.

### B-3. THERMOCOUPLE METHOD

**B-3.1** The two conductor between which thermoelectric effect is produced shall be soldered or welded at the hot junction.

**B-3.2** When applied to the surface of a live conductor the hot junction shall be covered with insulation and shall be wrapped with tin foil as described for bulb thermometers.

**B-3.3** The protective pad of heat insulating material specified in **B-3.2** shall be employed whether the junction is insulated or hot.

**B-3.4** The coil junction shall be immersed in oil, preferably contained in a vacuum flask, the temperature of which is measured by means of a thermometer.

**B-3.5** When a thermocouple is used to measure the temperature of a resistor, both tin foil wrapping and pad shall be omitted.

### B-4. SELF-RESISTANCE METHOD

**B-4.1** In the self-resistance method, normally used for copper only the temperature rise of a winding is determined by the increase in the resistance of the winding itself.

**B-4.2** The temperature of the winding as measured by thermometer before beginning the test should not differ from that of the surrounding medium. The initial resistance and initial temperature of the winding will be measured at the same time, for example, for copper, the ratio of hot temperature  $T_2$  to cold temperature  $T_1$  may be obtained from the ratio of hot resistance  $R_2$  to cold resistance  $R_1$  by the following formula:

$$\frac{R_2}{R_1} = \frac{T_2 + 234.5}{T_1 + 234.5}$$

*NOTE* — A simple method, giving results only slightly less accurate than above may be employed for the majority of cases. In this, temperature rise is calculated on the assumption that it amounts to 1°C for every 0.4 percent increase in resistance.

### B-5. MEASUREMENT OF AMBIENT TEMPERATURE

**B-5.1** The temperature of the surrounding air shall be measured by means of at least two thermometers so placed as to take account of the maximum and minimum ambient temperatures and the mean reading shall be adopted. Each thermometer shall be immersed in oil contained in and sufficient to fill a bottle having a capacity of about 250 ml.

# APPENDIX C

( Clause 0.4 )

## CLEARANCES AND CREEPAGE DISTANCES

### C-1. CLEARANCES AND CREEPAGE DISTANCES

**C-1.1** It is not practicable to lay down rules relating to clearances and creepage distances which may be applied to all the diverse types and size of controlgear and accessories, as so much depends on variable factors, such as atmospheric conditions, nature of insulation employed, the provision made for arc quenching, number of planes across which creepage can take place.

**C-1.2** When arcing is liable to occur, it is not possible to lay down even tentative figures, which might not be misleading and generally speaking barriers are employed so that laying down of figures for clearance in such cases would not serve any useful purpose.

**C-1.3** The values in Table 2 are given only as a guide to what may be regarded as minimum values which apply to non-arcing parts in favour of circumstances.

**TABLE 2 CLEARANCES AND CREEPAGE DISTANCES IN AIR TO EARTH OR BETWEEN POLES OR PHASES**

RATED VOLTAGE	UP TO 10A		OVER 10A UP TO 10A		OVER 50A		ALL CURRENTS	
	Clea- rance	Cree- page	Clea- rance	Cree- page	Clea- rance	Cree- page	Clea- rance	Cree- page
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	mm	mm	mm	mm	mm	mm	mm	mm
Up to 250 V	6	9.5	6	12.5	9.5	12.5	—	—
Above 250 V and up to 440 V	6	11	8	12.5	9.5	12.5	—	—
Above 440 V and up to 650 V	9.5	12.5	9.5	12.5	9.5	12.5	—	—
Above 2.2 kV and up to 3.3 kV	—	—	—	—	—	—	50	50
Above 3.3 kV and up to 6.6 kV	—	—	—	—	—	—	65	65
Above 6.6 kV and up to 11 kV	—	—	—	—	—	—	76	102

NOTE — With oil immersed apparatus, clearances and creepage distances may be reduced below the value given in the table, provided that the apparatus may withstand the high voltage test specified in 10.2.

**APPENDIX D**

( Clause 10.1.2.1 )

**RECOMMENDED SAMPLING PLAN FOR ACCEPTANCE TESTS****D-1. LOT**

**D-1.1** In any consignment all the rheostats of the same make and manufactured under similar conditions of production, shall be grouped together to constitute a lot.

**D-1.2** Sample shall be taken from each lot and tested for acceptance tests.

**D-2. SCALE OF SAMPLING**

**D-2.1** The number of rheostats to be selected shall be in accordance with col 1 and 2 of Table 3.

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**TABLE 3 SCALE OF SAMPLING AND PERMISSIBLE NUMBER OF DEFECTIVES**

( Clauses D-2.1 and D-3.1 )

LOT SIZE	SAMPLE SIZE	PERMISSIBLE NUMBER OF DEFECTIVES
<i>N</i>	<i>n</i>	
(1)	(2)	(3)
Up to 10*	3	0
11 to 25	8	1
26 and above	13	1

\*When the lot size is 2 or below, the entire material shall be tested and no defective shall be allowed.

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**D-2.1.1** The rheostats shall be selected at random from each lot. For this purpose, provisions for random sampling as given in IS : 4905-1968\* shall be adopted.

**D-3. NUMBER OF TESTS AND CRITERIA FOR CONFORMITY**

**D-3.1** The rheostats selected as per col 1 and 2 of Table 3 shall be tested for acceptance tests. If a rheostat fails in any one of the acceptance tests, it shall be called a defective. If the number of defectives in a lot is found to be equal to or less than the corresponding permissible number of defectives (see col 3 of Table 3), the lot shall be considered as conforming to the acceptance tests, otherwise it shall be rejected.

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\*Methods for random sampling.

**AMENDMENT NO. 1      MARCH 1981**  
**TO**  
**IS : 9051-1979    SPECIFICATION FOR RHEOSTATS**

**Addendum**

( Page 6, clause 4.2 ) — Add the following new matter after 4.2:

**4.2.1** The preferred ratings of current and resistance shall be chosen from the values given below:

Current A	Resistance Ω						
18	0.4	0.6	1.0	1.6	2.5	4	6.3
16	0.4	0.6	1.0	1.6	2.5	4	6.3
12.5	0.6	1.0	1.6	2.5	4	6.3	10
10	1.0	1.6	2.5	4	6.3	10	16
8.0	1.6	2.5	4	6.3	10	16	25
6.3	2.5	4	6.3	10	16	25	40
5.0	4	6.3	10	16	25	40	63
4.0	6.3	10	16	25	40	63	100
3.2	10	16	25	40	63	100	160
2.5	16	25	40	63	100	160	250
2.0	25	40	63	100	160	250	400
1.6	40	63	100	160	250	400	630
1.2	63	100	160	250	400	630	1 000
1.0	100	160	250	400	630	1 000	1 600
0.8	160	250	400	630	1 000	1 600	2 500
0.6	250	400	630	1 000	1 600	2 500	4 000
0.5	400	630	1 000	1 600	2 500	4 000	6 300
0.4	630	1 000	1 600	2 500	4 000	6 300	10 000
0.3	1 000	1 600	2 500	4 000	6 300	10 000	11 000

( ETDC 48 )